atim cloud wireless™
PRODUCT LINE

Atim Cloud Wireless®

Input 4-20mA or 0-10V

User Guide

 ACW-MIO-C0	 ACW-MIO-2M8
 ACW-MIO-C1	 ACW-MIO-1M8

Concerned Models :

ACW/MIO-C0

ACW/MIO-C1

ACW/MIO-2M8

ACW/MIO-1M8

LoRaWAN™ sigfox ready LTE-M NB-IoT

ATIM Radiocommunication
77, Imp. du rosé des près
38250 Villard de Lans
France

www.atim.com
info@atim.com
+33 4 76 95 50 65

Table of contents

This user guide is applicable to the following references

Designation*	Version
ACW/xxx-MIO-C0	with cable gland, delivered without cable
ACW/xxx-MIO-C1	with cable gland, supplied with 1m cable
ACW/xxx-MIO-1M8	1 female M8 connector (1 ana input + 1 ToR)
ACW/xxx-MIO-2M8	2 female M8 connectors (2 ana + 1 ToR inputs)

Technologies /xxx :

- ACW/LS8: LoRaWAN / Sigfox (LoRaWAN by default)
- ACW/CEL: Cellular (NB-IoT / LTE-M)

Version history of this document

Version	Date	Description	Author	Affected Software Version /Revision
1.0	26/02/2025	Creating the document	JH	V1.0.0 / A.0
1.1	06/05/2025	Corrections	ER	V1.0.0 / A.0
1.2	13/10/2025	Corrections	SC	V1.0.0/ A.0
1.3	5/02/2026	Corrections / addition of references	JR	V1.0.0/ A.0

Disclaimer

The information contained herein is subject to change without notice and does not represent a commitment on the part of ATIM.

Trademarks and copyrights

ATIM, ACW, ATIM Cloud Wireless®, ARM Advanced Radio Modem® are registered trademarks of ATIM Sarl in France. Other trademarks mentioned herein are the property of their respective owners.

Declaration of Conformity

All ACW Atim Cloud Wireless® products comply with the regulatory requirements of Directives 2014/53/EU (RED) and 2011/65/EU (RoHS), if used in accordance with the intended use, the following standards have been applied:

CE

1 Safety (Article 3.1a of Directive 1999/5/EC)

NF EN60950-1 Ed. 2006/A1:2010/A11:2009/A12:2011/A2:2013 (health)

EN62311:2008 (Power> 20mW) EN50385 EN50581

2 Electromagnetic compatibility (Article 3.1b of Directive 1999/5/EC)

EN 301489-3 v2.1.0, EN 301489-1 V2.1.1

3 Efficient use of the radio frequency spectrum (Article 3.2 of Directive 1999/5/EC)

ETSI EN300 220-2 v3.1.1

4 Cyber Security

The **EN18031** standard is composed of 3 points:

a) EN 18031-1 – Network-Connected Devices

b) EN 18031-2 – Wireless devices processing personal data

c) EN 18031-3 – Wireless devices involved in monetary transactions

All ACW Atim Cloud Wireless® products are not affected by points (b) and (c), as personal and transaction data are stored on the gateway and server side (LNS, IoT platform, and smartphone terminals, computers, etc.).

Regarding point (a), ATIM equipment operating in LoRaWAN, proprietary LoRa, and Sigfox are not concerned because they are not connected directly on the networks. Direct access is not possible from the LAN network or from the Internet.

Environmental recommendations

a. Environment

Observe the storage and operating temperature ranges of the products. Failure to do so could disrupt operation and even damage the equipment.

Follow the precautions and instructions listed below to ensure your safety and the safety of your environment and to prevent damage to your device.

General Hazard *– If instructions are not followed, there is a risk of damage to equipment.*

This product is powered by low voltage 10 to 30V direct current only – Be careful to check the polarity!

This symbol means that the product should not be disposed of with unsorted household waste. This product is subject to selective collection of electrical and electronic equipment, in accordance with the regulations in force. At the end of its life, it must be deposited at a collection point provided for this purpose (waste disposal centre, take-back point at a distributor, specialised sector, etc.), in order to allow: the recovery and recycling of materials, the limitation of the impact on the environment and human health. For more information on the collection and recycling channels available, check with your local authorities, your distributor or the manufacturer where you purchased the product.

a. Radio

The ACW series modems are part of the radio communication modems using the ISM (Medical Scientific Industry) bands that can be used freely (free of charge and without permission) for industrial, scientific and medical applications.

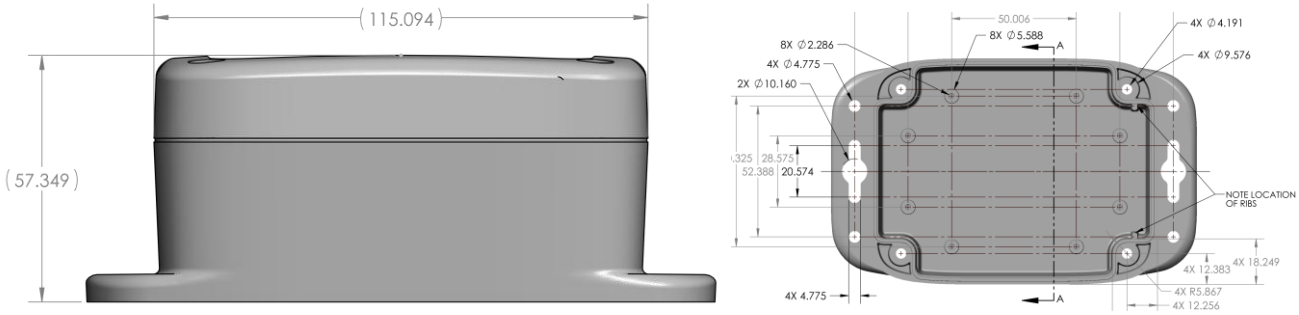
Technical characteristics

Dimensions	147 x 87 x 58 mm		
Antenna	Integrated (1/4 wave) – External antenna option on request		
Temperature	-20°C to +55°C (Operating)		
	-40°C to +70°C (storage)		
Fixation	By 4 screws or 2 hose clamps		
Case	Industrial – IP66/67 and IP68 on request (MOQ required)		
Power	1 pack of 3.6V / 7.2 Ah Lithium batteries / 2 packs in CEL version		
Weight	100 g		
LTEM Frequencies	B1/B2/B3/B4/B5/B8/B12/B13/B14/B18/B19/B20/B25/B26/ B27/B28/B66/B75/B85		
LoRa / Sigfox Frequency	EU 863 – 870 MHz		
Power	25 mW (14 dBm)		
Version Radio	LTE-M/NB-IoT : NA		
	Sigfox : NA		
	LoRaWAN : v1.0.4		
Flow rate	LTEM : 1119 Kbit/s		
	NB-IoT: 158.5 Kbit/s		
	Sigfox : 100 bits/s		
	LoRaWAN : 250 bit/s à 5.5 Kbit/s		
Consumption	LTEM/NB-IoT	Sigfox	LoRaWAN
Mode Tx	45 mA	60 mA	30 mA
Mode Rx	45 mA	50 mA	5 mA
Mode Sleep	13 µA	15 µA	15 µA

Case

a. Dimensions

The dimensions below are given in millimetres.



b. Fixation

The ACW-MIO is secured by four screws that fit into the four mounting holes on the back of the housing or with one or two hose clamps.

b. Installation

For optimal results, it is recommended to install the enclosure without environmental obstructions and to place it at a height of approximately 1m50. It must be mounted on a vertical stand.

For information, the antenna is integrated into the housing, on specific request it can be moved outside using an SMA connector.

c. Wiring

The internal terminal block allows you to connect 4 wires:

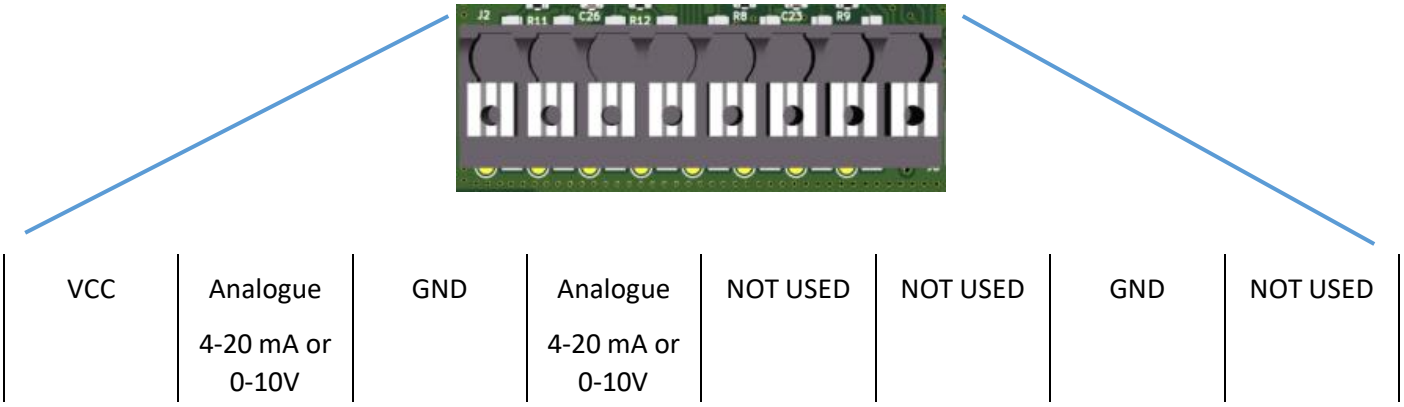
- SIG1: 4/20mA or 0-10V sensor input (reconfigurable as ToR input)
- SIG2: ToR input (configurable to state change or counting)
- VCC: External sensor power supply
- GND : Ground (Masse 0V)

Versions 1M8 (2 inputs) and 2M8 (4 inputs)

The same signals are found on each M8 connector (4 female points):

1- GND
2- VCC*
3- SIG1
4- SIG2 or unwired

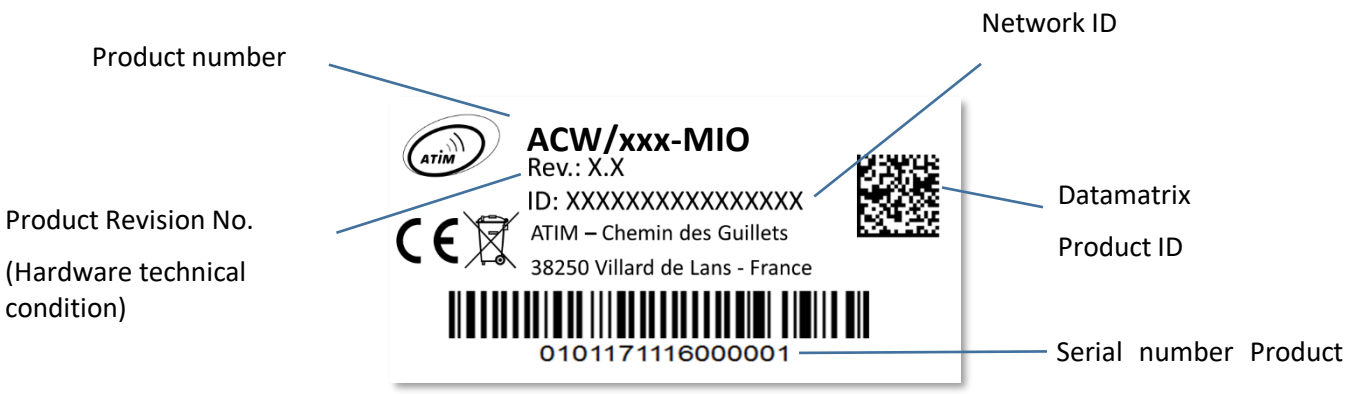
** Controllable output 5V, 12V or **24V / 90mA** (for power supplies) – Default: 24Vdc*



d. Identification

The product's Sigfox or LoRaWAN or LTEM/NB-IoT identifier can be seen on the outer label on the back of the product, on the inside on the electronic board, and in the status bar of the ACW configurator.

For LoRaWAN modems, the communication keys are automatically given by the network (pairing by "Over The Air Activation", or OTAA).



Operation

a. Operating Mode

To find out the state of the product, simply run a magnet briefly (<2 sec) against the QRCODE label, which causes the LED light to come on. The color of the LED indicates the mode of operation of the product as described:

Storage Mode : This mode optimizes the life of the batteries by preventing them from oxidizing. The product does not emit and waits patiently for it to be woken up.

Network Pairing Mode: This mode is active when the product exits storage mode or boots up after a power outage (battery change) and allows pairing to a network.

Configuration mode: this mode is active about **4 minutes** after pairing with the network and allows the product to be configured via **Bluetooth** using the PC configurator or the ATIM mobile application. During these few minutes, messages are sent by radio every minute (5 "radio frames" spaced one minute apart), making it possible to check that the product is working well, for example after placing it under a cast iron manhole. After this period, the product goes into operation mode and Bluetooth is disabled (it can be reactivated via **Downlink**).

Operation Mode : This is the default mode after the product startup phase. In this mode, the module periodically sends measurements depending on the configuration applied (if the product has never been configured, the factory configuration applies, cf. Factory Configuration).

Internal Fault Mode: This mode allows the normal operation of the module to be interrupted when a critical event occurs. The nature of the event can be multiple:

Empty battery (Battery voltage< 2.2V)

Internal error of the radio module

System Error

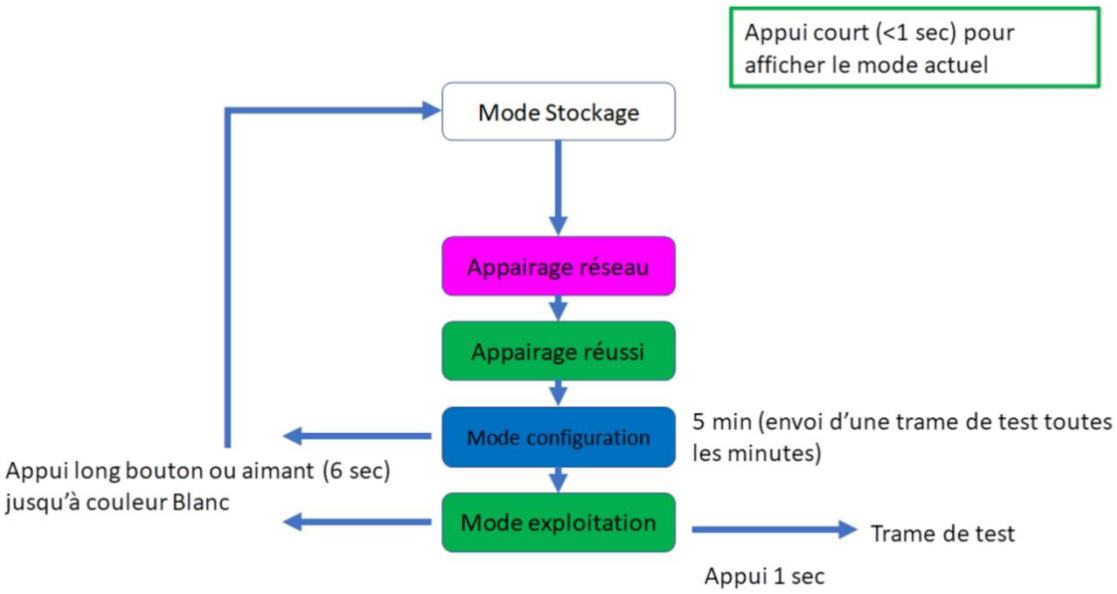
Entry into this "Internal Fault" mode is indicated by a RED flashing of the product LED.

If the error does not prevent the use of the radio module, the product will send a radio frame every 24 hours containing the error code(s) (see chapter Frame Format for error codes). In addition, the product will emit a light warning depending on the nature of the event.

Once in this mode, the module must be restarted (by disconnecting and then reconnecting the battery, by Downlink command or with the magnet) to return to normal operation.

b. Product Commissioning

Battery-operated products are delivered in storage mode.



◯ Unless otherwise requested, ACW products are delivered with connected batteries and put into "storage" mode.

To place the product in its operating mode, hold a magnet against the QRCODE label for **6 seconds**. During these six seconds, the product's LED should flash **WHITE** until it enters the pairing phase.

● The ACW then enters the network peering phase. During this phase, a **FUSCHIA** light flashes every 45 seconds, indicating that the search phase is in progress.

In case of successful connection, the product will emit a light signal indicating the quality of the network :

- **GREEN** light signal : good network quality
- **YELLOW** light signal: average network quality
- **ORANGE** light signal: poor network quality
- **WHITE** light signal: no information on network quality (Sigfox only)

● The module will then enter its operating mode and start to send the information back to the network depending on the configuration.

NOTE
In the LoRaWAN version, in the event of a connection failure (no Join Accept received by the product), the ACW will go into simple standby and make a next pairing attempt every day until it successfully joins the network.

Special case

For a Sigfox product

- To have information on the quality of the Sigfox network (**GREEN**, **YELLOW** or **ORANGE** light signal), it is necessary to provision a Sigfox Downlink. It is this that will make it possible to rule on the quality of the network. The product emits a test uplink at startup as described in the Classic Frame (0x02 Frame Type) chapter. If a Sigfox Downlink is provisioned, the information on the network quality will then be transmitted by the ACW (light signal). If no downlink is provisioned, then the ACW will always show the **WHITE** light signal at the end.
- If a **WHITE** light signal at the end of the pairing phase is emitted by the product and a Downlink has been provisioned, it means that the Network is not accessible (downlink not received by the ACW).
- If a **WHITE** light signal at the end of the pairing phase is emitted by the product without a downlink having been provisioned, this has no significance for the quality of the network. The quality of the network can be good as well as bad (or non-existent).

For a LoRAWAN product

- In the default LoRAWAN Class A operating mode (see chapter Radio module configuration), if at the end of the 5-minute pairing phase, no network has been joined, then the product goes to sleep and will restart a 5-minute pairing phase 24 hours later. Thus, if the product is placed in an area not yet covered by the network, the product will join it when connectivity is possible. There is no need to intervene on the product for it to join the network.

c. Sending a test frame

When the product is in its operating mode **(and only in this mode),** it is possible to emit a test frame (which avoids waiting for the next measurement frame) including a measurement sample.

To do this, simply hold the magnet close to the QRCODE label, which lights up the LED **GREEN** and wait for it to turn off before immediately removing the magnet. The successful sending of the test frame will be indicated by a **CYAN** light signal.

d. Putting into Storage Mode

During transport or storage of the ACW, it is best to place it in its storage mode to avoid unnecessary energy consumption.

From any operating mode (except fault mode), hold a magnet against the QRCODE on the case for **6 seconds**.

During these six seconds, the product's LED will flash in the color corresponding to the current mode of operation and then the end of the sequence will be indicated by a **WHITE** fade acknowledging that the product has been put to sleep. The magnet can therefore be removed.

e. Radio Module Activity

During Setup Only mode, each emission of a test frame is indicated by three short flashes of **GREEN** color from the LED.

By default, radio transmissions in Operation mode are not indicated by these LED flashes. However, it is possible to configure the product so that all radio emissions are indicated by these LED flashes (see LED flashing).

f. Threshold exceedance

When the LED flashing setting is activated, the thresholds have been activated and the measurement values exceed these thresholds, the product LED will emit an ORANGE periodic flash every 5 seconds to notify it.

g. Battery de-passivation

All new generation ACW products incorporate a battery depassivation feature, preventing battery oxidation during prolonged storage phases. This feature is automatically activated as soon as the product enters its storage mode. The product will then be woken up once a week to start the battery depassivation sequence.

ACW Configurator

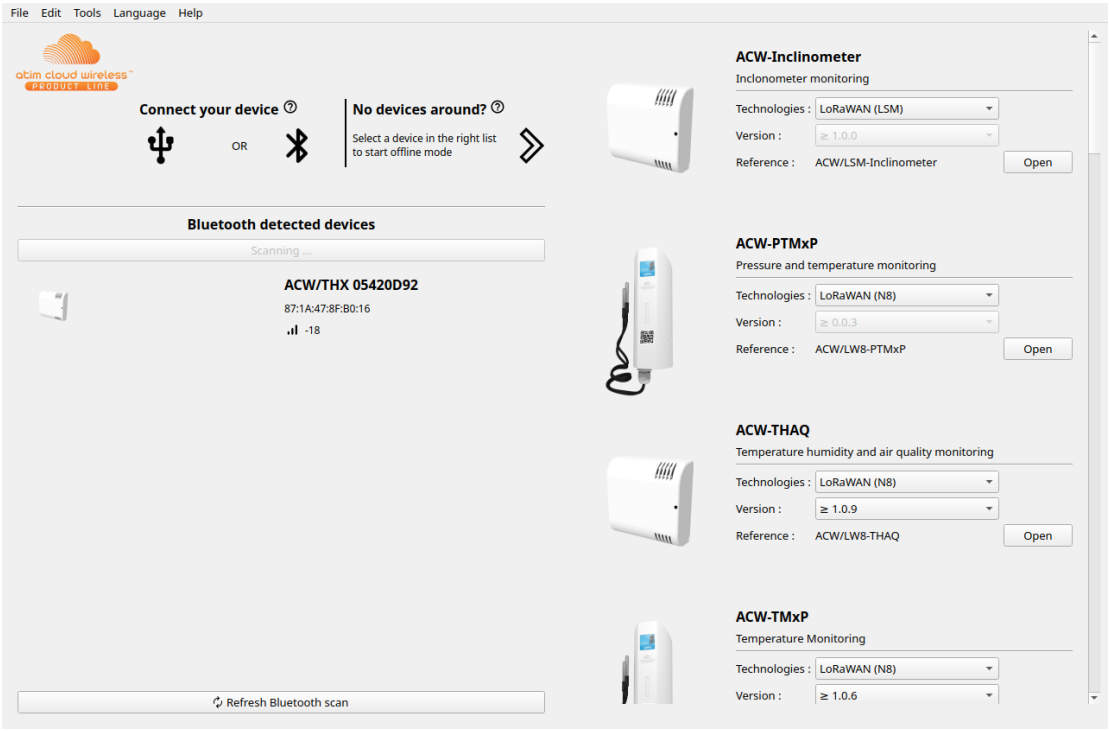
a. Compatible configurator versions

For a MULTIO with the following application software version :	Use the ACW Configurator version :
Sigfox : V1.0.0 (revision A.0)	V5.5.9 or higher
LoRaWAN : V1.0.0 (revision A.0)	V5.5.9 or higher
LTEM/NB-IoT : V1.0.0 (Revision A.0)	V5.5.9 or higher

Download and install the latest version of the ''setupACW.exe'' configuration software at:

https://www.atim.com/wp-content/uploads/documentation/CONFIGURATEUR/ACW/configurateur-acw.exe

NOTE
The product must be in its Configuration mode in order to be detected by the configurator. As a security measure, configuration is only possible for 5 minutes after the product is started. To switch the product back to Configuration mode in order to be able to connect to the configurator, you must first switch the product to storage mode (close magnet for 6 seconds), wait about twenty seconds for the entry into storage mode to be effective, then wake up the product (magnet 6 seconds again). The product can then be configured.



When you launch the ACW Configurator, the waiting window is displayed on the screen.

The product can be paired with the configurator only via Bluetooth.

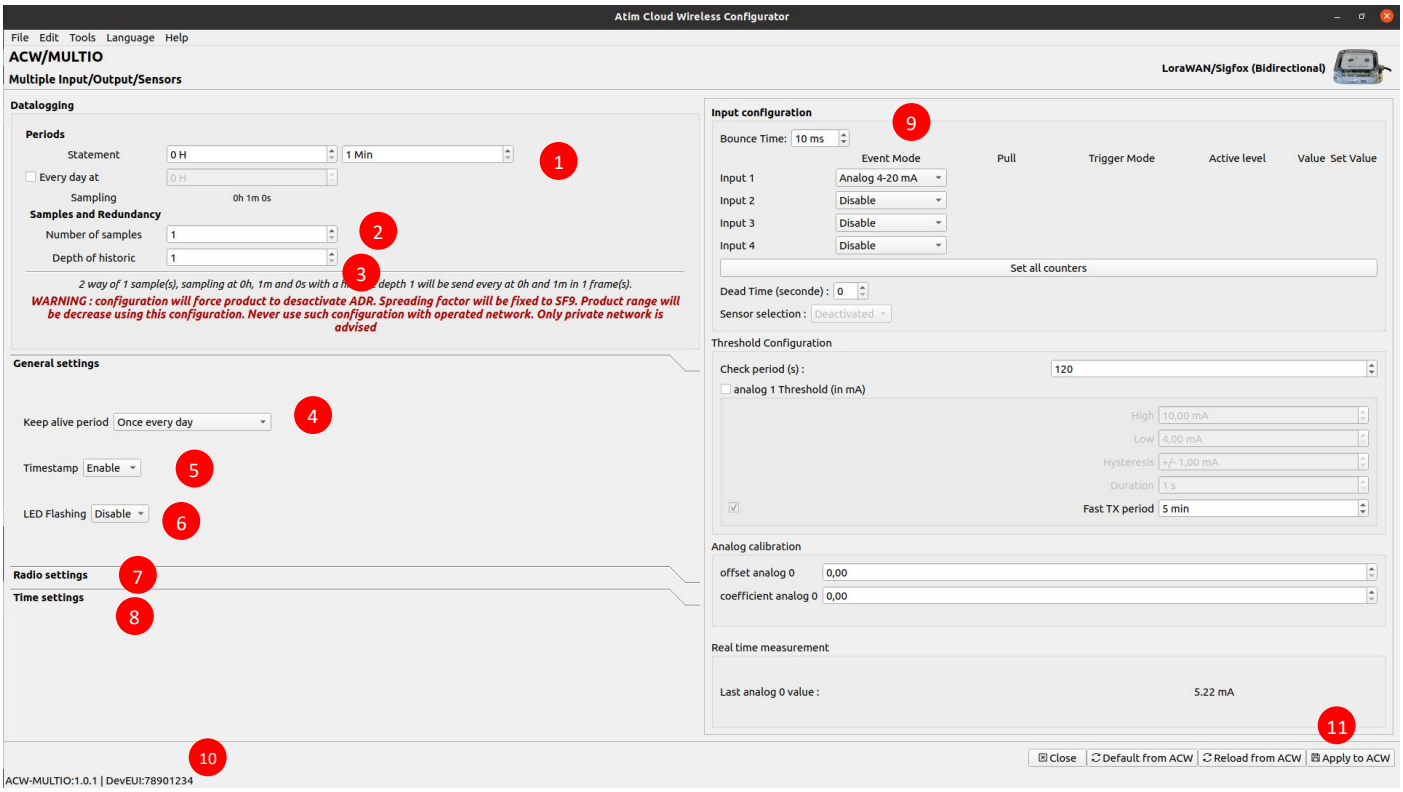
Before launching the software, it is necessary to enable Bluetooth on the computer. The computer's Bluetooth chip must be able to handle at least version 4.0 of the standard in order to be compatible with the "Bluetooth Low Energy" variant used by ACWs.

The list of detected ACWs is displayed on the left side of the configurator. You have to double-click on a product to connect to it.

When connected to the configurator, the product emits a brief **BLUE** light signal.

WARNING
Avoid leaving the product connected to the configurator for too long, as this will degrade the autonomy of the product.

b. Product Configuration



Emission period and number of samples in the frame

The transmission period 1 corresponds to the time interval between each sending of a measurement frame. This period can be configured (in 1-minute increments) of :

- 1 min to 255h for a LoRaWAN product
- 10min to 255h for a Sigfox product
- 15min to 255h for an LTEM / NB IOT product
- Possibility to check the shipment at a fixed time.

The emission period is set by default to 1 hour.

WARNING
If the transmission period is less than 4 minutes on a LoRaWAN product, an alert message will be displayed to warn the user that the ADR (Adaptive Data Rate) will be disabled, and that the product will set its Data Rate to SF9 in order to comply with the radio regulations concerning the duty-cycle. The radio range of the product will therefore be reduced.

It is possible to configure the number of samples in a frame 2. Thus, several measurements will be carried out periodically before the radio frame containing all these measurements is sent.

For example, with a period of 60 minutes and a sample count of 4, a measurement will be taken every 15 minutes and the 4 samples will be sent every hour. The set of values will be sent in several consecutive frames if the message to be

sent exceeds the maximum size of a radio frame; this is often the case in Sigfox where the maximum size of a frame is 12 bytes.

Finally, it is possible to apply data redundancy 3, which means that samples that have been sent in frames n-1, n-2 or n-3 can be sent again in frame n following the new measurement samples (the most recent sample first in the frame and the oldest last).

For example, for a history depth of 3, the data from the last 2 frames will be sent, in addition to the new data, in the new frame.

By default, there is only one sample per frame and no redundancy enabled.

TIP : HOW DO I INCREASE BATTERY LIFE?

Using the "Threshold" feature it is possible to set up 2 different cycle times, a "slow" one in standard operation, e.g. 1 measurement and emission every 2 hours and a "fast" one, e.g. 1 measurement and emission every 10 minutes. The "fast" operation being defined by "Fast Tx Period" should be taken into account in this case only in cases where the temperature is outside the comfort thresholds.

Period of the life frame

A life frame can be emitted periodically 4. This frame will contain the supply voltage of the product.

The value of this period can be configured from 1 hour to 1 month.

By default, the value is set to 1 day.

Frame timestamp

It is possible to disable/enable the timestamp of all radio frames 5.

WARNING
This option, when enabled, monopolizes 4 bytes in the frame that cannot be used for sensor data. These 4 bytes will then represent the moment of acquisition of sensor data.

The timestamp uses the product's internal clock and its value will be wrong if the product has never been connected to the configurator, or at least not since the last battery change.

By default, the timestamp is disabled.

LED flashing

To generate LED flashes at each of the radio transmissions during the operation phase, as well as a regular LED flashing during the threshold exceedance phases, it is necessary to activate this option 6.

When the option is disabled, the LED will still flash when transmitting test frames, operating mode changes, pairing, etc.

Radio module configuration

Depending on the version, it is possible to change the mode of communication. The possible choices are LTEM, NB-IoT, LoRaWAN, Sigfox or Local mode.

The choice can be made in the 7

In LTEM mode, we can change the server information by clicking on the "MQTT Config" button. This opens a page with the information currently stored in the product. After changing the settings, click the "OK" button to save the new configuration or "Cancel" to cancel it.

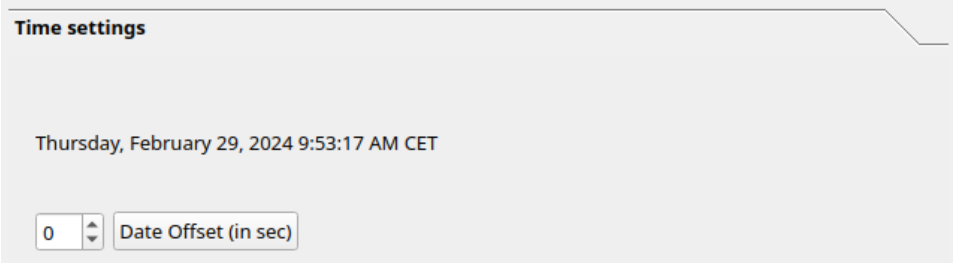
It is also possible to activate GPS measurement with an acquisition frequency based on the life frame.

Product Clock

When starting the product (after a battery change, for example), the internal clock is reset to 01/01/2024. Each time you connect to the configurator, the product's clock is updated (based on the computer's clock) and displayed [8]. A second offset between the computer clock and the product clock can be applied if necessary.

The internal clock can become out of sync little by little, on the order of ±1 second per day.

However, if your product is configured in LTEM, the product's internal clock will automatically update every day over the network.



Sensor Configuration

The configuration settings available for this sensor are as follows [9] :

Analog input

High and low threshold alerts can be configured.

Analog input calibration

It is possible to add an offset and a coefficient to the analog value.

Analog thresholds

High and low threshold values are configurable with a configurable hysteresis and confirmation system. When a measurement exceeds a threshold, the confirmation system initiates a second measurement 1 second later (configurable duration) in order to validate this threshold exceedance, then an alert radio frame is sent. An end-of-alert framework will be sent when we pass between the thresholds. See the chapter Alert frame for details on the format of the frame.

For example, in the case of a 4-20 mA analogy configuration with a high threshold of 10 mA and a hysteresis of 0.5 mA, an alert frame will be sent when the measured temperature exceeds 10 mA, and then an end of alert frame will be sent when the temperature falls below 9.5 mA.

The analog values of the input are displayed in real time on the configurator when the product is connected (these values are refreshed every 10 seconds).

Product versions

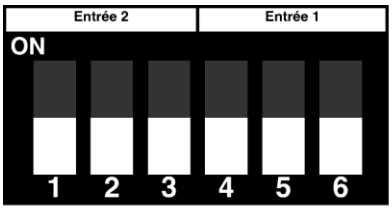
When connecting to the product, the configurator retrieves the software version of the product as well as the network identifier (ID in Sigfox, DevEUI in LoRaWAN) and displays them [10].

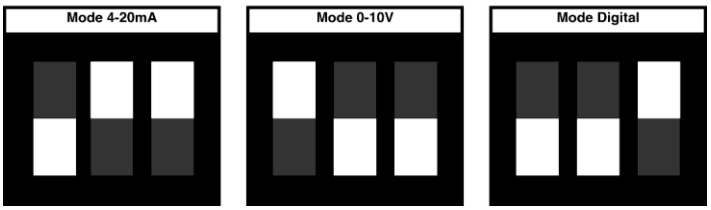
Configuration validation

After filling in all the configuration settings, it is imperative to click on the "Apply to ACW" button to send the configuration to the product 11.

It is also possible at any time to revert to the current configuration of the product (undo the last changes made to the configurator but not applied to the product) or reset the product configuration (revert to the factory configuration).

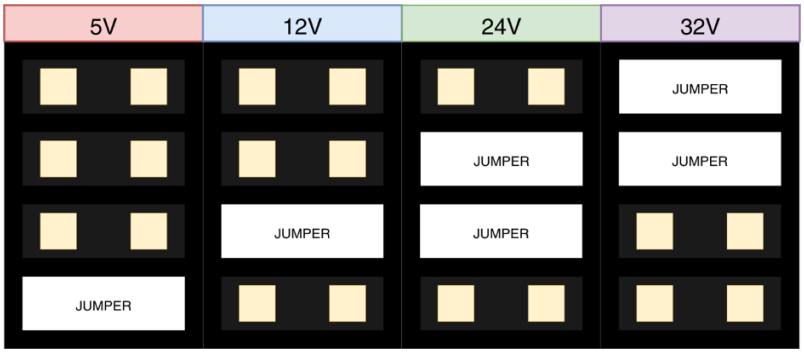
Configuration of the inputs in 4-20mA or 0-10V via the "dip-switch" present on the board:





Be careful not to touch the other switches at the risk of damaging the map!

Choice of output voltage for external sensor power supply :



c. Factory Setup

Radio Frame Settings

- Radio Broadcast Period: 1 hour
- Number of Samples: 1
- History Depth: 1

General Settings

- Period of sending the life story: 1 time per day
- Timestamp: Off
- LED Flashing: Off
- Radio Parameters:
    - LTEM

Sensor parameters

<u>Analog Input 1</u>

Threshold: Active

- High threshold: 10 mA
- Low threshold: 4 mA
- Hysteresis : 0,5 mA

As part of a 2M8

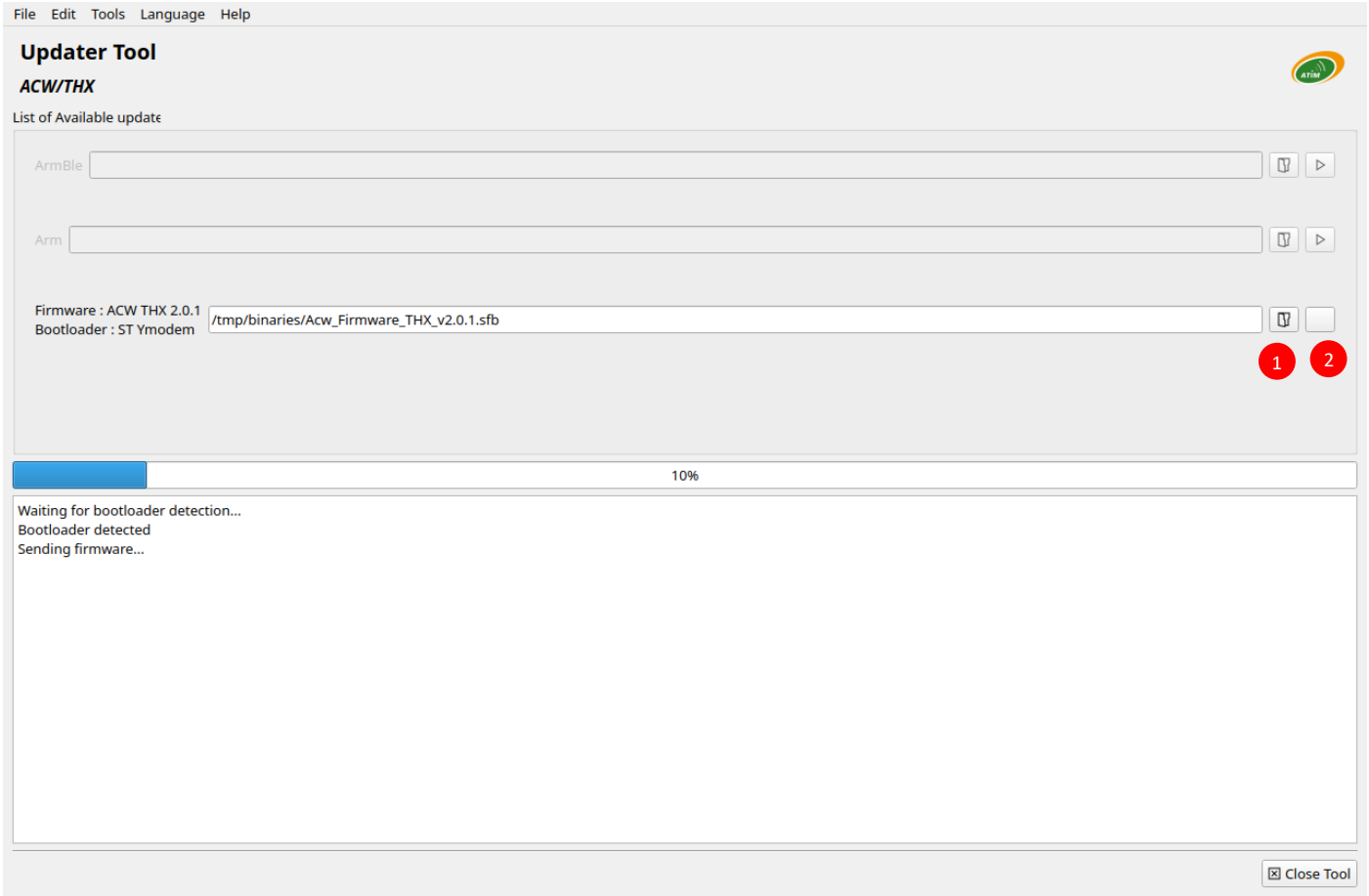
<u>Analog Input 2</u>

- Threshold: active
    - High threshold: 10 mA
    - Low threshold: 4 mA
    - Hysteresis : 0,5 mA

d. ACW Update

When connected via Bluetooth to the product, it is possible to update the internal software (firmware). The configurator will not automatically look for the latest firmware, the update file will be provided by the manufacturer or distributor.

You have to go to the *Tools->Updater (CTRL+U)* menu, click on the folder icon 1 to select the update file and click on the triangle icon 2 to start the update.



During the update, a progress bar appears to indicate the progress. At the end of the update, the product LED will display the colors of the rainbow to indicate the success of the update, ending with the color blue to indicate that the product is still connected to the configurator. The configurator will update the display of the firmware version number a few seconds later.

In case of an error during the update (disconnection of the product or crash of the configurator for example) :

- If the configurator update page is still open, when the button 2 becomes ungrayed again, restart the update.
- Otherwise (for example in case of configurator crash), restart the configurator and then reconnect to the product. The configurator will directly display the update page and it will be possible to restart the update (which will restart from the beginning).

WARNING
After a failed update, do not attempt to remove and then replace the battery of the product, as in this case the product update via Bluetooth will no longer be possible! If possible, restart the update within minutes in order to preserve the battery level (the consumption of the product is not negligible in the update mode).

Avoid running the update in an environment where several products already use Bluetooth Low Energy, to avoid radio interference generating untimely disconnections.

Update in FOTA

Thanks to LTEM, we can update the product remotely. To do this, simply send a downlink with the HTTP link in it. Once the downlink is sent, the product will download the file and then start its update. Once the update is complete, the product will restart.

The following items are updated by uploading files via HTTPS protocol :

- Server certificate
- Module certificate
- Private key
- Product Configuration File
- Software update file

To initiate the download, the following downlink must be sent :

Downlink change period							
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	…	Byte X
0xC1	Size	0xF1	File to download	URL	URL	…	URL

Byte 2 is the size of the downlink from byte 3.

Byte 4 indicates what type of file is to be downloaded:

0x01: Server certificate file download

0x02: Downloading the module certificate file

0x03: Downloading the private key file

0x04: Download the MQTT configuration file

0x05: Download the software update file.

From byte 5 onwards, the downlink must contain the URL of the file to be downloaded.

Example:

0xC12AF105https://atim.com/acw-fw/Acw_Firmware.sfb: Software update request. (0x05) with the URL as a parameter

Caution : The maximum URL size is 209 bytes. If the URL is longer than 209 bytes, the URL will be truncated and the download will not take place.

Once the downlink is sent, the product notifies the successful receipt by sending the "**start download**" frame. The product then begins downloading.

Once the download is complete, the product notifies the end of the download:

By sending "**download complete, file size: XX"**: if the download was successful. XX is then the byte size of the downloaded file

By sending "**download error: YY"**: if the download failed. YY then matches the error code

For the three certificates, once they have been downloaded, a command must be sent to switch the certificates to the new version. To do this, you have to send the downlink 0x01F0

Error Code	Error information
206	Partial Content
400	Bad Request
404	Not Found
408	Request Time-out
500	Internal Server Error
600	Not HTTP PDU
601	Network Error
602	No memory
603	DNS Error
604	Stack Busy
620	SSL continue
65535	Other Errors

The MQTT configuration file must comply with the following formalism :

"ClientId":"865456053640510"

"UserName":"rabbit"

"Password":"rabbit"

"Host":"37.153.140.203"

"PublishTopic":"data/ATIM/865456053640510"

"SubscribeTopic":"subscribe/ATIM/865456053640510"

"PORT":"8883"

"APN":"iot.1nce.net"

"TLS_Version":"TLS1.2"

With *the* editable fields in green.

e. Re-issuing unreceived frames

One of the features of this product in LTE-M / NB-IoT is the return of unreceived frames. If the product is unable to send its frame, then it is saved, and then when the next frame is sent, the product will try to resend the frames that were not received.

UPLINK Frame Format

a. Description

Frame Uplink			
Byte 1	**Byte 2**	**. . .**	**Byte n**
Frame header	Frame-specific data		

There are three types of frames:

- **Classic frame; New generation** : Very similar to the old frames, the difference is that you can activate the timestamp. These are, for example, the life frame, the error frame, the response to configuration frames, etc. These latter frames are common to all ACWs, but it is also possible to have other independent frames for each of the ACWs.

- **Weft measure; Next generation** : These frames are made up of samples of the different values of each of the channels that can be recorded by an ACW. Beforehand, the number of samples and the depth of the history will be inserted in the header.

NOTE
The number of samples and the depth of the history are common for all channels in the frame.

- **Alert framework (threshold exceedance); Next generation** : These screens combine a classic screen and a measurement frame. They consist of a header warning that a threshold has been exceeded, followed by samples from each of the pathways for which a threshold has been exceeded.

Classic frame

Byte 1 - header							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Next generation = 1	Timestamp = 1 - enabled 0 - Disabled	Measured frame = 0	Reserved = 0	Type of frame (see below)			

If the Timestamp is enabled, 4 bytes with the value of the Timestamp will be preceded by the header (byte 1).

The different types of frames

Frame Type	Data size	Description of the frame
0x00	--	Reserved
0x01	4 bytes	Fabric of life
0x02	0 bytes	Downlink Request for Network Testing
0x03	--	Reserved
0x04	--	Reserved
0x05	1 octet	Test frame with counter
0x06	Variable	(Cfg box) Response to a configuration frame
0x07	Variable	(Cfg box) Responding to a Command Frame
0x08	Variable	(Cfg box) Responding to an erroneous frame
0x09	Variable	Extended Measurement Frame
0x0a	--	Reserved
0x0b	--	Reserved
0x0c	--	Reserved
0x0d	Variable	Alert frames, follow-up of samples of alert channel measurements
0x0e	TBD	General error - TBD (memory, ...)
0x0f	Variable ...	Specific framework for this type of ACW

Measuring frame

Byte 1 - Header							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
New generation = 1	Timestamp (Off = 0, On = 1)	Measured frame = 1	History Depth (-1) Max : 4		Number of Samples (-1) Max : 8		

If the Timestamp is enabled, 4 bytes with the value of the Timestamp will be preceded by the header (byte 1).

WARNING
If the History Depth or Sample Counts field is greater than 1, the period of transmission of a frame (in minutes) will be added after the header and will occupy 2 bytes (Big Endian encoding, MSB first)

For each of the channels, a header is inserted in a row and is constituted as follows:

Byte 2 Header Way							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved = 0		Track number		Type of Measurement			

Type of possible mesure

Type of Measurement	Units	Data size	Data type	Descriptions
0x0B	mA	2 bytes **(Big Endian - MSB)**	Unsigned integer	Quantity in hundredths of mA: • Resolution: 0.01 mA • Max value: 20.00 mA • Min value: 0
0x0A	V	2 bytes **(Big Endian - MSB)**	Unsigned integer	Magnitude in hundredths of V: • Resolution: 0.01 V • Max value: 10.00 V • Min value: 0
0x0C	%	2 bytes **(Big Endian - MSB)**	Unsigned integer	Quantity in hundredths of mA: • Resolution: 0% • Max value: 100% • Min value: 0

This is followed by data from the measurement sample(s) (depending on the product configuration).

NOTE
When a frame has more than one sample per channel (number of samples > 1 or history depth > 1), the samples are organized from newest to oldest.

The number of bytes sent can be determined in the following way:
(Measurement byte size) * (number of samples) * (history depth)

EXAMPLE
For the 0x08 measurement type (the size of a value is two bytes) with a history depth of 2 and a sample count of 3, the size of the data to be read would be 12 bytes (2x2x3).

Extended Measurement Frame

The extended measurement frame presents the data in the same way as the measurement frame. The only change is before the measurements. The framework looks like this:

Bytes	Bit	Description
0		This byte is the header presented above that is 0x89 or next 0xC9 if the timestamp is enabled.
1-4		If the timestamp is enabled, we'll see it there.
1-4 or 5-8		The weft index.
9 or 10		The value of the history number.
10-11 or 11-12		The value of the sample number over 2 bytes.
12-13 or 13-14		The sample time value between 2 measurements.

Measurement alert frame

Byte 1 - Header							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
New generation = 1	Timestamp (Off = 0, On = 1)	Measured frame = 0	Reserved = 0	Alert frame (= 0x0d)			

If the Timestamp is enabled, 4 bytes with the value of the Timestamp will be preceded by the header (byte 1).

For each of the channels in alert, a header is inserted and is constituted as follows :

The **alert type field** allows you to identify whether it is an exceedance of the high threshold, the low threshold or a return between the thresholds.

Byte 2 - Header Way							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Alert Type		Track number		Type of Measurement			

These values are defined as follows :

Value	Description
0x00	Back between thresholds
0x01	Exceeding the high threshold
0x02	Exceeding the low threshold
0x03	Reserved

The measurement type field here is the same as that of the measurement frame (see **Measuring frame**).

The sample that caused the alert is then inserted in succession (with an encoding in **Big Endian** – MSB first).

Life story

The life frame is sent at regular intervals depending on the configuration applied (default 1 day) and contains the battery levels of the product "empty" (when the product is not doing anything) and "charging" (when the product is emitting a radio frame).

Byte 1 - Header							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
New generation = 1	Timestamp = 0	Weft Measure = 0	Reserved = 0	Life frame = 0x01			

Following this header are 4 bytes, 2 for the battery level at no load and 2 for the battery level under charge.

The plot is therefore divided as follows: 0xAABBBBCCCC

0xAA is the header of the frame (always equal to 0x81), 0xBBBB the no-load battery level (millivolt value, MSB encoding) and 0xCCCC the battery level under load (millivolt value, MSB encoding).

EXAMPLE
0x81 0d24 0c68
0x0d24 : no-load battery level = 3364 mV or 3.364 V
0x0c68 : battery level under load = 3176 mV or 3.176 V

If the product is configured in LTE-M or NB-IoT mode, you have the option of having the GPS (GNSS) position of the product integrated into the life story.

The plot is therefore divided as follows: 0xAABBBBCCCCDDDDDDDDDDDDDD

0xAA is the header of the frame (always equal to 0x81), 0xBBBB the no-load battery level (millivolt value, MSB encoding), 0xCCCC the battery level under load (millivolt value, MSB encoding), and 0xDDDDDDDDDDDDDD the GPS position.

The GPS location contains several data explained in the table below.

Bytes	Bit	Description
0	7	Must be at 0; when it is set to 1, it indicates a hardware problem communicating with the GPS (for example, the GPS's daughter card is no longer attached to the motherboard).
	1	Indicates hemisphere (1: northern hemisphere; 0: southern hemisphere)
	0	Indicates direction for longitude (1: east; 0: west)
1-3		Latitude, in thousandths of a minute of arc (1/60000 degrees). An unsigned value in Big Endian format. A value 0xFFFFFF indicates that the location was not found.
4-6		Longitude, in thousandths of a minute of arc (1/60000 degrees). An unsigned value in Big Endian format. A value 0xFFFFFF indicates that the location was not found.

EXAMPLE
0x81 0d24 0c68 03293EE90513C6
0x0d24 : no-load battery level = 3364 mV or 3.364 V
0x0c68 : battery level under load = 3176 mV or 3.176 V
0x03293EE90513C6 : the position is GPS 45°3'4.9"N 5°32'44.5"E

General Error and Alarm Frame

Byte 1 - Header							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Next Generation = 1	Timestamp = 0	Weft Measure = 0	Reserved = 0	Error frame = 0x0e			

If the Timestamp is enabled, 4 bytes with the value of the Timestamp will be preceded by the header (byte 1).

For each of the error messages, a header is inserted and is constituted as follows:

Byte 2 - Header Error Message							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Message Index			Error Message Length				

The **message index** field is used to prioritize messages when multiple errors occur.

The **error message length field** indicates the size in bytes of the error message.

The following byte identifies the nature of the error or alarm that occurred:

Byte 3 - Header Error Message		
Error Code	Nature of the error	Description
0x81	ERR_UNKNOWN	
0x82	ERR_BUF_SMALLER	The data table is full, unable to write additional data to it
0x83	ERR_DEPTH_HISTORIC_OUT_OF_RANGE	The depth of history is too large or too small for the frame
0x84	ERR_NB_SAMPLE_OUT_OF_RANGE	The sample number is too large or too small for the frame
0x85	ERR_NWAY_OUT_OF_RANGE	The number of channels in the header of the frame is too large or too small
0x86	ERR_TYPEWAY_OUT_OF_RANGE	The measurement type in the header of the frame is too large or too small
0x87	ERR_SAMPLING_PERIOD	Poor sampling period structure
0x88	ERR_SUBTASK_END	End of a subtask after exiting an infinite loop
0x89	ERR_NULL_POINTER	Pointer with "NULL" value
0x8A	ERR_BATTERY_LEVEL_DEAD	Critical battery level
0x8B	ERR_EEPROM	EEPROM is corrupted
0x8C	ERR_ROM	ROM is corrupted
0x8D	ERR_RAM	RAM is corrupted
0x8E	ERR_ARM_INIT_FAIL	Radio module initialization failed

0x8F	ERR_ARM_BUSY	The module is already busy (possibly not initialized)
0x90	ERR_ARM_BRIDGE_ENABLE	The module is in bridge mode, impossible to send data by radio
0x91	ERR_RADIO_QUEUE_FULL	The radio buffer is full
0x92	ERR_CFG_BOX_INIT_FAIL	Error initializing the black box
0x93	ERR_KEEP_ALIVE_PERIOD	Poor structure of life frame period
0x94	ERR_ENTER_DEEP_SLEEP	The product has entered deep sleep mode
0x95	ERR_BATTERY_LEVEL_LOW	Low battery level
0x96	ERR_ARM_TRANSMISSION	A transmission was initialized but an error occurred
0x97	ERR_ARM_PAYLOAD_BIGGER	The size of the message is too large for the capacity of the network
0x98	ERR_RADIO_PAIRING_TIMEOUT	Unable to pair with a network before time runs out
0x99	ERR_SENSORS_TIMEOUT	A timeout has been reached on the sensor
0x9A	ERR_SENSOR_STOP	The sensor did not return a value during a reading
0x9B	ERR_SENSORS_INIT_FAIL	The humidity temperature sensor is not detected at startup.
0x9E	ERR_SENSORS_MOVE	Detection of displacement/theft on the product
0x9F	ERR_SENSOR_CRC_KO	Corrupted humidity temperature sensor data
0xA0	ERR_SENSOR_NO_DATA	Unable to read a temperature/humidity on the sensor.

Only the 0x8A and 0x95 codes are followed by additional data corresponding to the battery level in millivolts. This value is encoded in two bytes, the high-order byte first (MSB).

WARNING
For codes ranging from 0x81 to 0x92, the product will enter its FAULT mode and will no longer perform its measurement function. For codes ranging from 0x93 to 0xA0, these correspond only to alarms, so the product continues to function normally.

b. Examples of frame

Measuring frame

With timestamps disabled, no history and a sample count of 1 (analog, internal temperature and external temperature):

Octet		
1	2	3 and 4
0xA0 (new generation measurement frame, no history, 1 sample)	0x0B (channel 0, measurement type: analog)	0x0578

The product returns values of 0x578 (14.00 mA analog input)

Now with a sample count of 2 :

Byte							
1	2 and 3	4	5 and 6	7 and 8			
0xA1 (new generation measurement frame, no history, 2 samples)	0x003C (period of issue)	0x0B (channel 0, measurement type: analog)	0x03E8	0x04B0	0x1A (channel 0, measurement type: analog)	0x0018	0x00E8

Bytes 2 and 3 indicate the period of transmission, in this case 60 minutes (so a sample is measured every 30 minutes).

- The first sample on channel 0 is 0x03E8 (10.00 mA)
- The second on channel 0 is 0x04B0 (12.00 mA)
- The first sample on channel 1 is 0x0018 (0.24 V)
- The second on channel 1 is 0x00E8 (2.32 V)

NOTE
This example is valid for the product with a LoRaWAN module. In the case of Sigfox, the size of an Uplink is 12 bytes and therefore this frame is divided in two.

Extended Measurement Frame

Byte							
1	2 to 5	2 and 3	4	5 and 6	6	7	8
0x89 (extended measurement frame, no history, 1 samples)	0x0000000A	0x00	0x0000	0x003C (Period of Issue)	0x0A (channel 0, measurement type: analog)	0x02	0x30

Bytes 2 and 3 indicate the transmission period, in this case 60 minutes.

- The sample is 0x230 (5.6 V)

NOTE
This example is valid for the product with an LTEM module.

Measurement alert frame

For a high threshold exceedance on track 1, the grid will be:

Byte			
1	2	3	4
0x8D (New generation alert framework)	0x5B (Exceedance of high threshold channel 1, temperature measurement)	0x02	0xC9

The sample that triggered the threshold is 0x02C9 (7.13 mA)

Downlink

This feature is available on all ACWs.

Downlinks allow :

- Modify the product settings
- Send orders to the product

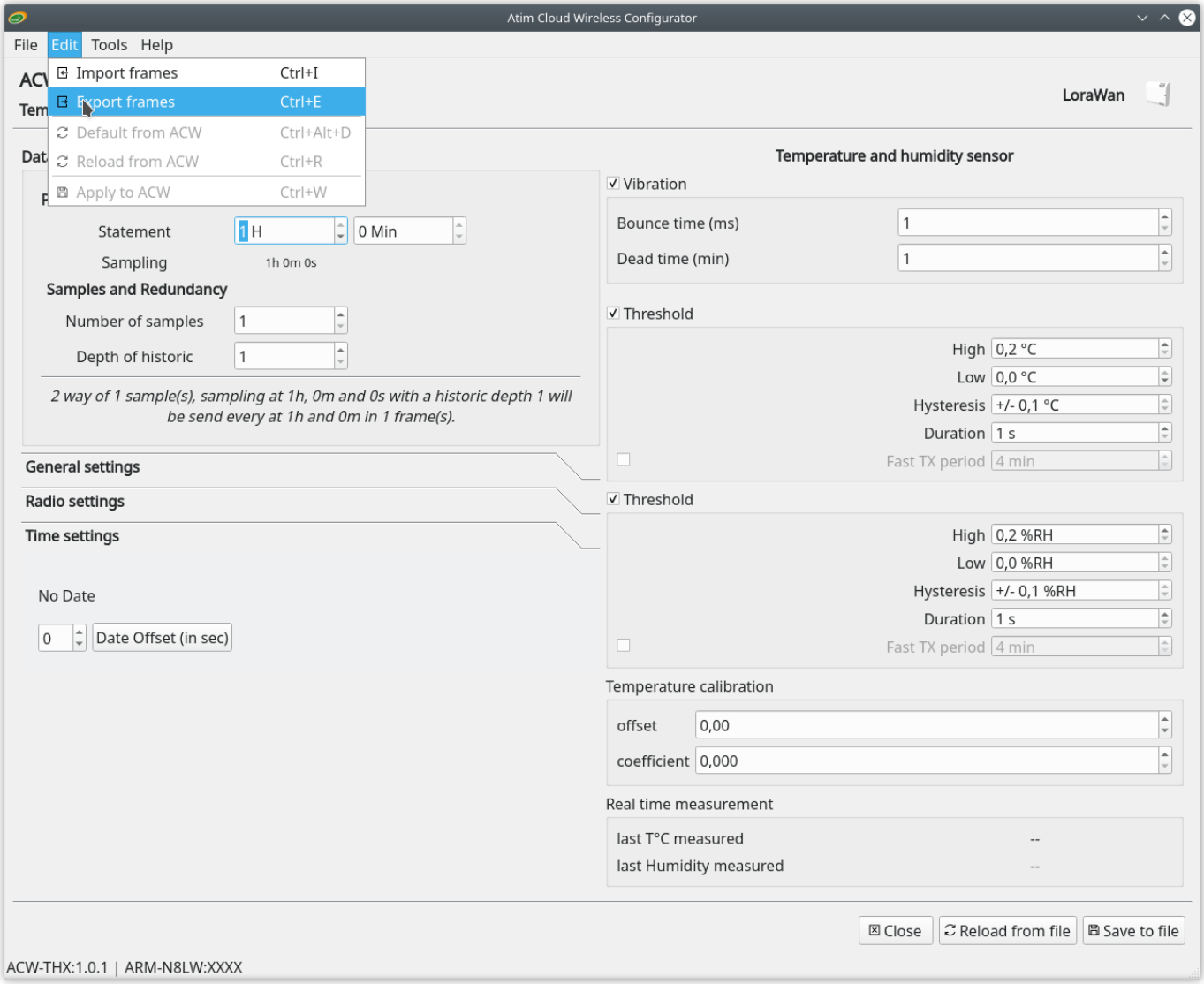
The operation of the Downlink is explained in document ATIM_ACW-DLConfig_UG_FR_v1.4, relating to the version V1.2.0 of the ATIM Downlink Protocol (see this document for all parameters and commands common to all products).

a. Changing settings

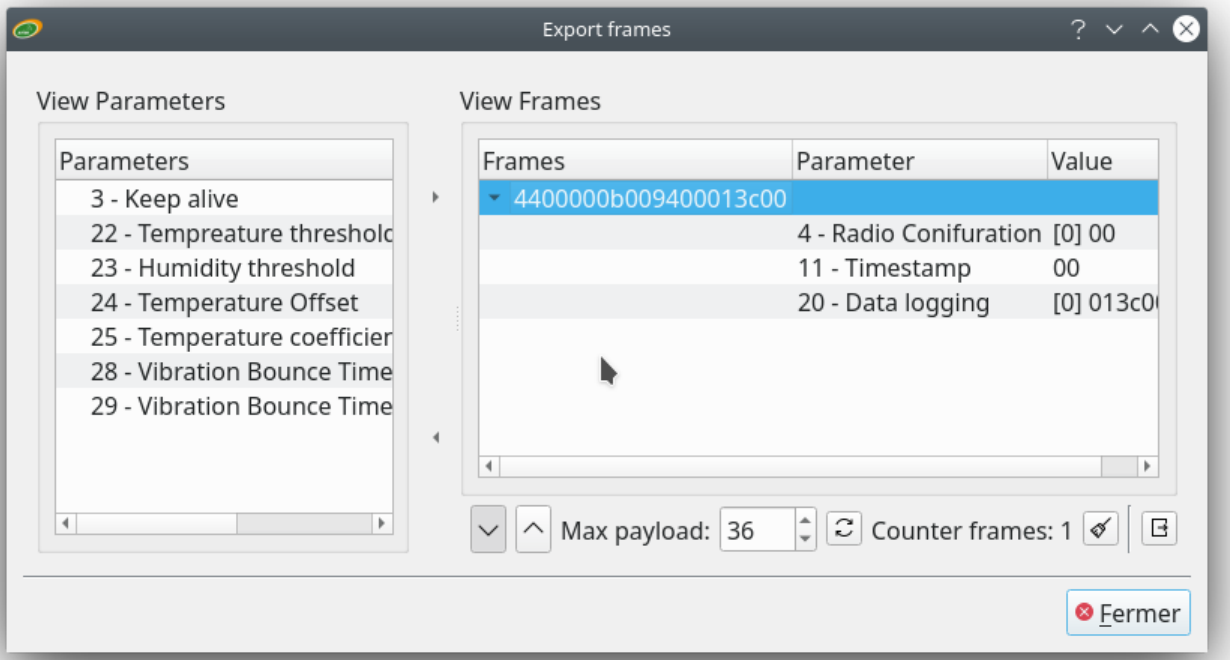
The content of the downlinks can be generated using the configurator to be able to set up a product remotely. These generated downlinks will then be sent via the Sigfox or LoRaWAN network.

To do this :

- Open the product configuration page (you can open a virtual page corresponding to the product by selecting the correct ACW reference from the list on the right if the product is not physically within range)
- Build your desired configuration
- You can then export the parameters using the menu (Edit->Export frames) :



- All you have to do is select the parameter(s) you want to apply via downlink and build the associated downlink. For example, here, we want to modify the radio configuration, timestamp and datalogging parameters. The downlink to be sent will then be in hexadecimal 4400000b009400013c00



WARNING
For Sigfox products, downlinks are limited to 8 bytes. The maximum size of the downlink can be adjusted via the "Max payload" parameter.

b. Sending downlink commands

The full functionality of Downlink commands is explained in document ATIM_ACW-DLConfig_UG_FR_v1.4, relating to version V1.2.0 of the ATIM Downlink Protocol.

Technical support

For any information or technical questions, we invite you to open a ticket on our dedicated support web page: https://www.atim.com/support-technique/